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PLACENTAL INFARCTS.

by

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From early times, certain abnormalities in the appearance of the placenta have been noted, but an organ whose function was completed with its delivery was for long deemed not worthy of pathological in-:vestigation. The best historical survey of opinions as to the nature of these abnormalities is to be found in an article by J. Whitridge Williams, published in 1900, and the following quick survey of pathological thought up to that time is based in large part upon that article.

The first reference in the literature appeared in 1668, when Mauriceau called attention to certain white areas in the placenta. To these he gave the name of "schirrus of the placenta," but no further details or theories were advanced as to the nature of these white areas, and the ideas as to etiology were reflected in the terms used by different pathologists at this time. Cruveilhier called them "atrophy," Brachet, Wilde, Simpson, Hegar, and Maier, believing them to be inflammatory in nature called them "placentitis". Brachet and Scanzoni saw a similar-:ity to the stage of red hepatization of the lungs in pneumonia, and used the term "hepatization". "Placental apoplexy" was suggested by Cruveilhier, at a later date, and supported by Jacquemier, Gierse, Meckel, and Soanzoni, while Klebs used the term "hematoma". Simpson, believing them to be tuber-:culous in origin, termed them "phthisis" of the placenta, while Barnes, Robin, Charpentier, and Ternier /

Ternier believed them to be due to fatty and fibro-fatty degeneration. They were described variously as fibrinablagerungen, fibrinanhangungen, fibrin-keils, fibringerinnungen by Rokitansky, Spaeth, and Wedl, Klob, Valenta, and Eberhardt. Bustamente, Slavjansky, Rohr, Martin, and Delore believed they were due to some form of thrombosis, but the term "infarct," which is in common use to-day was appar-:ently first applied by Ollivier. Rokitansky, Hoffman, Ackermann, and others, later gave their support to this theory. Zilles believed they were all syphilitic and described them as "gummata," and Clemenz was the first to use the word "neorosis" in this connection. Jacobson thought they were due to a hyaline degeneration of the decidua, while Steffock, suggested rather a decidual proliferation.

Williams, himself, in a study of 500 cases at this time gave as his theory that the cause was arterial changes in the villous vessels, and that the primary change was an endarteritis and periarteritis occurring most frequently in the medium-sized villi. This theory was apparently first promulgated by Ackermann in 1884 and supported by Eden in 1897.

Since 1900, many writers have been inclined to favour this view of Williams', among them Siddell and Hartman who suggested that at least one type of so-called infarct was due to this cause. Frankl, McNalley, and Dieckman, Adair, and Frank believed that this could be a cause, but was not the only or the /

the most usual cause. John Fraser, who injected the venous and arterial systems in young and also mature placentae, believed that his findings supported Williams, Eden, and Ackerman.

Many of the older theories have been discarded as obviously unsound. For instance, it is quite untenable that all such areas in the placenta can be due to syphilis, as suggested by Zilles, or to tuberculosis, as suggested by Simpson. A few of the ideas preceding Williams' article are still upheld by occasional workers. Talbot adheres to the idea that a placentitis is the origin of the changes; other writers have not supported him.

There is a growing body of thought to the effect that the change which usually takes place is a localized degeneration of the villous syncytium with a superimposed process resembling thrombosis. The latest article on the subject, one which describes this process accurately and in detail is by Montgomery (1931). He ascribes the origin of the idea to Hitschmann and Lindenthal (1903), but I find it foreshadowed in Eden's article in 1897 where, after supporting the endarteritis and periarteritis theory, he describes the possibility of the occurrence of degeneration of the syncytium with deposits of fibrin binding the villi together. Many writers in varying manners have outlined the same process, among them Clemenz, who suggests the name "white necrosis", McNally, and Siddell and Hartman, who believe /

believe it to be the cause in one type of lesion.

All recent writers agree that pathological areas occurring in the placenta, areas which have hitherto been slumped together as "infarcts" are not necessar-:ily the result of one process. Williams, himself, gives a division into six classes:

1. Small whitish or yellowish fibrous forma-:tions, occurring in either the fetal or maternal surfaces, and measuring from 1 mm. to 3 cm.
2. Wedge-shaped white infarcts.
3. Large white infarcts involving one-half to almost all the placenta.
4. Marginal infarcts.
5. Red infarcts more prominent on the maternal surface.
6. Roundish areas 1 to 3 cm. in diameter, con-:sisting mostly of Blood.

Siddell and Hartmann suggest after a study of 700 consecutive placentae that there are four types. These they describe in their article as I, II, III, and IV, and give detailed macroscopic and microscopic descriptions. For instance, I. is irregular and grey, and microscopic examination reveals fibrin ex-:tending to outlying villi, while the centre is solid and consists of degenerated villous stroma with fibrin and fragments of clots. Unfortunately, any but the closest reading gives no clarity of class-:ifications in their four types.

McNalley /

McNalley gives a clearer division. He holds they may be roughly grouped into three types:

1. Areas which have the appearance of a white infarct, but which are merely masses of fibrin which have replaced a previous collection of blood.
2. Infarcts such as Young describes, which are red to begin with and become white.
3. Senile infarcts which are due to syncytial changes.

Adair (1923) simply makes the statement that all white infarcts do not fit into the same category.

All of this leaves a large vague field in an understanding of the pathology of so-called "infarcts" of the placenta, and this study is directed towards a classification of this field. The scope of this paper is three-fold. In the first place, it is to prove that the term "infarct" is not generally applicable; in the second place, it endeavours to draw up a pathological classification which shall be based upon immediate etiology and which shall be self-explanatory; in the third place, it shows in how far pathological findings and clinical data can be co-related.

Procedure and premises

The material and methods employed merit a short description. Two hundred placentae from consecut-:ive deliveries at St. Mary's Hospital, Rochester, Minnesota /

Minnesota, were examined macroscopically and microscopically. Experience showed that if the placentae were examined in the fresh state, they conveyed much less information than after ten to fourteen days' fixation in formalin, so examination was made in most instances between the tenth to the fourteenth day. Measurement of the diameter was made on the uterine surface. Any area of change on either foetal or maternal surface was observed, and the insertion of the cord was noted. For convenience, the cord insertion was described as velamentous, battle-dore, paramarginal (anywhere on the outer third), paracentral (anywhere in the middle third), and central (anywhere in the central third). Then the placenta was cut in slices of about 1 cm. thickness, and any changes noted. Wherever any area suggested pathological change, a section was taken, and stains were applied (which will be described throughout the text), according to the particular detail desired to be shown. All these microscopic sections were later co-related with their macroscopic appearances. The histories of these 200 cases were then studied, and data noted which will be referred to later. It is the results of these studies which I desire to present, drawing from them conclusions which appear justifiable.

In order to draw these conclusions, certain premises must be allowed, and these premises involve a certain amount of discussion.

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In the first place what do we mean by infarction? MacCallum, after describing slighter grades of anemia says, "More complete anemia commonly causes death of the affected part, and this is the all important feature in the production of infarction.....The cells lose the aspect which they possessed during life. They are dead cells entangled and held in a coagulum which involves the whole area of tissues". The emphasis is mine, as I wish to refer back to it later. Subsequent paragraphs show that he believes the essential cause to be blockage of nutritive blood supply to a certain area, notably blockage of an artery. This, in turn, involves the destruction of a whole area of specialized tissue at one time, and customarily gives rise to certain reactive changes, while the tissue destroyed undergoes simultaneous death. "The whole area is dead and reminds one, in viewing it through the microscope, of the streets of Pompeii, as contrasted with those of a modern town". (MacCallum).

Moreover, it is assumed throughout this paper that the chorionic villi are nourished by the maternal blood. The placenta is an organ with a dual circulation each circulation being apart and separate. The foetal circulation is, in the placenta, contained in the villous vessels, while the maternal circulation is contained within the large sinusoids surrounding these villi. At no place is there any mixing. Young advances several arguments to /

to prove that the whole nourishment of these villi comes from the maternal side. He points out that in the early development of the placenta when the villi are not themselves vascularised at all, growth is very rapid; and that in hydatidiform mole, where the mesoblastic villous core contains relatively few vessels, again growth is rapid. Further, fragments of undegenerated syncytium have been found in other organs of pregnant women, and in such a situation, the only possible source of nourishment is maternal. In ectopic pregnancy also, fragments of undegenerated syncytium may be found growing, yet detached from the ovum. In placental syphilis, there is fibrosis of the villous stroma without syncytial degeneration. To these arguments of Young's, it is possible to add one other: in the placentae I have examined, separation from the mat-:ernal blood supply for any cause (in the majority of cases from a retroplacental hemorrhage) has invar-:iably caused death of a greater or smaller amount of chorionic tissue, whereas blockage of the fœtal circulation, which occurs occasionally to a marked degree in the form of endarteritis obliterans of the villous vessels does not cause death of the villi blocked, or of surrounding smaller villi. Adair, while raising certain objections to Young's theories, has been unable to find fault with his premises, and I believe it is now generally accepted that the source of supply to the chorionic villi is solely the maternal blood.

In /

In view of the terminology later suggested, one other short preliminary discussion is not out of keep-:ing. I refer to the subject of thrombosis. Welch defines thrombosis as a "solid mass or plug formed in the living heart or vessels from constituents of the blood". Later he discusses the possibility of the occurrence of a purely fibrinous thrombus and decides that such may occur attached to necrotic en-:dothelium, and does occur in such cases as croupous pneumonia. In this article of Welch's, there follows a very interesting discussion as to the causes of thromboses, some points of which have bear-:ing on this paper. He points out that Schimmelbusch has shown that the blood platelets circulate centrally in the blood stream and only leave this position when the circulation is sufficiently diminished. Such diminution takes place when there is local circulatory disturbances, as when there is interruption or narrowing of the lumen by ligation or compression or circumscribed dilatation. Von Recklinghausen emphasizes the importance of an eddying motion of the blood. Both of these points will be touched on later.

Suggested classification.

In the placentae examined, with one exception only, every specimen showed some variation from normal placental tissue, which was visible to the naked /

naked eye. Sometimes such areas were very small, and in these cases they were usually situated marginally; sometimes they were very large, involving a half or more of the total placental tissue. In appearance also, they varied considerably. In some cases, they were white and hard, in others they were whitish and laminated, while in yet others they appeared to consist for the most part of blood. In no case was it absolutely possible to diagnose exactly what construction to put upon these pathological areas, without making microscopic study, and co-relating this with the naked eye appearance.

After examination of comparatively few specimens, it was possible to divide the lesions into three large groups.

The first group comprised these areas which had apparently undergone that process described by Hitschman and Lindenthal, and more completely by Montgomery. This change was the one most universally found, and only one placenta was entirely free from it. The appearance varied with the extent of involvement (See Fig. 1.). In the cases least involved, only occasional villi showed the change. The stroma of these villi in the earlier stages, showed little change, but at some point on the syncytial margin, there was degeneration or absence of the syncytium, and adhering to this a small homogeneous non-cellular and evenly staining mass, (See Fig. 5). This, of course, projected into the lumen of the maternal sinus. It would be easy to see how further degeneration of the syncytium would

would produce more of this same deposit, and how de-:generation of the syncytium of neighbouring villi would bring about a deposit capable of obliterating at that point the maternal sinus. When a villus was wholly surrounded by this process, the stroma, like other tissues cut off from blood supply, showed degeneration. When several villi became involved, the same process was at work, and the end result was an area wherein were degenerating villi which lacked syncytial covering and were surrounded by this homogeneous material. (See Fig. 6.).

I believe, with the other supportersof this theory, that the original change is the syncytial de-:generation, and that the substance deposited comes from the maternal blood and consists of fibrin. I have examined preparations of this process both in the earlier and in the later stages, stained with various stains. Mallory's phosphotungstic acid stain was most conclusive, and when sections stained with this were compared with similarly stained sections of a normal blood clot, there remained no doubt whatever that this homogeneous matter was fibrin. Reverting to Welch's article, it is poss-:ible to get a thrombus composed of fibrin only, and in other respects this deposit fulfils the definition of a thrombus. The gradual extension of this thrombus depends on degeneration of the walls of the villi, and therefore it seems to me that the most suitable /

suitable term to apply to this process is "mural thrombosis".

This mural thrombosis occurred in my series to a greater or lesser extent in 99.5 per cent of cases. The one exception was placental tissue of a six weeks' pregnancy which had been removed from the uterus by curettement. It was therefore assumed that this process was a concomitant of maturity in the placenta, but not, as far as we were able to observe, that its degree was an index of maturity.

Three observations, which have not, I think, been made before may be worth reporting in this connection.

One is that every marginal "infarct" showed this particular pathological change. In certain instances where a whole lobe at the margin was involved, another change to be described later was also present, but even in these cases it was possible to distinguish areas of this type.

Another point of interest is that where the whole thickness of the placenta was involved to some extent, the subchorionic area was invariably involved to a more marked degree than the subdecidual. These observations suggest that "thrombosis" is certainly a more correct descriptive term than "infarct", for the marginal area and the subchorinnic area are the most distant areas of maternal circulation, and, hence, the areas where there would be the most marked slowing /

slowing of the current, and also the most marked eddying motion of the blood (See Welch's article).

The third observation which may be of interest is the relation of the amount of marginal mural thrombosis to the insertion of the cord. Talbot, in a very interesting and suggestive, but not sufficiently well-founded article, assumes that a normal placenta enlarges concentrically and therefore at term, a normal placenta should have a centrally situated cord. Where the cord is not central, infarction has occurred at a certain period of growth stopping development in that direction, so that the distance from the infarct to the base of the cord gives a reasonable estimate as to the time in the pregnancy when the injury occurred. The further conclusions which he draws from this are not at the moment relevant. If this were so, then we would be justified in concluding that, with an ex-centrically situated cord, pathological change should occur only, or at least to the most marked degree, on the periphery nearest to the cord. Out of this series of 200 cases, cord insertions occurred in the following percentages:

Central insertion	21.5 per cent
Paracentral	29 per cent
Paramarginal	41.5 per cent
Battledore	6 per cent
Velamentous	2 per cent

The situations of the marginal infarctions were studied /

studied in the paramarginal, battledore, and vela-:mentous placentae, as, a fortiori, these placentae should show change in the side nearest to the cord. In the paramarginal cases, it was found that for thirty-nine cases where the most marked change was on the near side, thirty-eight cases showed it on the opposite side, twenty-nine cases showed it laterally, and seventeen cases showed a change to be indefinite. The battledore and velamentous placentae were still more indefinite in the situation of these pathological changes. In our series, therefore, Talbot's primary assumption cannot be said to be borne out.

This group of "mural thromboses" forms the first large group of pathological conditions which produce white firm areas, hitherto known as "infarcts". These vary in size and in location, but have similar histoligic appearance, and apparently similar immediate etiology, though definitive and essential etiology is unknown. Montgomery believes that the essential etiology is some substance circulating in the maternal blood which causes the first injury to the syncytium. Hofbauer endeavours to prove that this substance is histamine. Datnow has experi-:mentally produced what he describes as "coagulation necrosis" followed by hemorrhage and abortion by using various preparations containing lead. Results obtained in this study seem to suggest that the whole process may be the result of placental maturation, with /

with slowing of the current of maternal blood, aging of the tissues, and a more or less mechanical thrombosis. "Elles sont des stigmates de senescences" concludes Rivière.

The second group of lesions may be described with justification as "true infarcts". When, for any reason, there is stoppage of the nutritive blood supply to any area of placental tissue, this area undergoes certain definite predictable changes. In the first place, anexemia having been shown to be the controlling mechanism for the dilatation or contrac-:tion of the chorionic vessels, there is dilatation and engorgement of the affected area, while the maternal sinuses are devoid of blood. (See Fig. 7). When seen naked-eye, this stage of infarction shows as a swollen dark red area, usually next the decidua and roughly triangular in shape, with moderately sharp delimitation. (See Fig. 2). In the continued absence of nutriment, the villi undergo a simultan-:eous degeneration, throughout which the elements, including the syncytium are clearly recognisable, though, as MacCallum says, like "the streets of Pompeii as contrasted with those of a modern town". (See Figs. 8 & 9). This process has, thus, two stages: the stage of villous vessel dilatation and engorgement when the affected part of placenta is firmer than the surrounding tissue and stands out a purplish red colour, which gradually fades into fibrous tissue stages where the affected tissue appears /

appears in the placenta as pink, greyish, or white.

There are those who could maintain that the process first described, in so far as it also is a local anemia is also a true infarction. Perhaps sufficient arguments have already been advanced in favour of the name "thrombosis," but it may be worth while to add a few words. In the first place, this is obviously a totally different process with a marked histologic difference, and merits a different name. This is, indeed, the type of infarct describ-:ed by Young and believed by him to be the etiology of eclamptic conditions. In the second place, in the thrombotic process, there is a gradually in-:creasing change, whereas in the process of infarction, there is a change, simultaneous in character, which follows a sudden complete blockage of nutriment. Obviously the latter process fulfils the accepted idea of infarction.

The immediate etiology of this process is stoppage of the maternal blood supply. This may be brought about in various ways, much the most common being retroplacental hemorrhage. Other possibilities are decidual infection, or the formation of a com-:plete barrier due to mural thrombosis with resultant true infarction, usually small, in the blocked-off areas. Yet another possible cause is an intra-:placental collection of blood or hematoma sufficiently large to separate the distal villi from the maternal blood supply. In such cases it was often /

often possible to demonstrate small true infarcts on one side of the clot, and it is significant that the location was always on the side distal to the decidua.

In the series of 200 cases, true infarcts, either large or small, could be demonstrated histologically in 35 per cent. The reason for the blockage of maternal blood supply was ascertainable histologically in 93.5 per cent of these infarcts, and in 63 per cent a recent or an old retroplacental hemorrhage could be postulated. In 1 per cent only could a definite localized inflammatory process be seen, whilst in the remaining 29.5 per cent infarcts, which were all small, the cause could be shown histologically to be either an intraplacental hematoma or a complete barrier of mural thrombosis. The co-relation with the clinical findings will be discussed later.

The third large group of pathological placental lesions, hitherto grouped under "infarcts", are intraplacental localized collections of blood, or hematomata. Early in this placental study, it was recognized that these were of two kinds. In many of the placenta, collections of blood, obviously recent, and varying from a few millimeters in diameter to ap-:proximately 3 cm. were noted. On histologic examination, the normal constituents of the blood were found replacing the cherionic villi in the centre and infiltrating between the cherionic villi at /

at the edges. It is logical to suppose that such lesions were only terminal, and represented a rush of maternal blood to an area in the placenta where the villi had become loosened from decidual attachment a little earlier than the general placental separation. It is probable that a careful search would have detected some such areas in all placentae, though large areas were only present in a certain percentage. Because of the probable terminal and physiologic nature of these lesions, they were, after histologic verification, discounted from further study.

There were, however, localized intraplacental blood clots, or haematomata, which could not be ex-:plained on this terminal hypothesis. To the naked eye, they appeared as pinkish, often laminated, or white fibrous areas (See Fig. 4). They varied from a few millimeters to several centimeters in diameter, and were usually sharply demarcated from normal placental tissue at the edges. Histologically, they consisted of blood clot in varying stages of fibrosis. In contradistinction to the other lesions described, they contained no evidence of cherionic villi whatever, and were sharply localized. In almost every such section examined, it was possible to find at one side or another, an area where a large number of villi had been bound together by the process of mural throm-:bosis. (See Fig. 10). In other areas, the clot was clearly defined, and normal villi came right to the edge of it. In reconstructing the various

stages /

stages in the production of such a lesion, it is possible to suppose that the more normal process, the mural thrombosis, occurred first. This must have extended locally until a barrier of villi had been built up at one spot, after which, for some cause there had been local detachment of several villi, and a local collection of maternal blood. It is reasonable to suppose that the cause in question is an increase in maternal blood pressure.

In this connection, the experimental work of Browne is of interest. He has shown, in rabbits, that, by setting up a chronic exalate nephritis and then causing an acute exacerbation of the nephritis during pregnancy it is possible to produce accidental hemorrhage, both external and concealed, in 100 per cent of cases. Browne and Dodds carried these experiments further, and it is worth appending two of their conclusions. They believe that ante partum hemorrhage is not due to organisms, but probably to the failure of the kidney to excrete poisons, which accumulating in the circulation ultimately lead to hemorrhage; their final conclusion is that the most important predisposing cause of accidental hemorrhage is chronic nephritis.

This study suggests that perhaps the essential cause is high blood pressure, and only in so far as kidney lesions commonly cause this rise in blood pressure are they responsible for the hemorrhages in the placenta. Indeed, clinically, in pregnant women, Browne /

Browne, in a still more recent article, points out that high blood pressure often precedes albuminuria with impending eclamptic conditions.

In the 200 cases examined, hematomata were observed in 39.5 per cent cases, while in 11 per cent of cases these hematomata were large. For the purpose of this study, a hematoma was considered large where its average diameter on out section was over 1 cm. It was noticed that such lesions were usually multiple and it was very rare to find a placenta with only one such hematoma.

Before proceeding to co-relate these conditions with the clinical findings, it might be useful to tabulate the suggested pathological classification:

Mural thrombosis:		
Marginal	99.5 per cent cases examined.	
General	99.5 per cent cases examined.	
True infarction	35 per cent cases examined.	
Red		
White		
Hematomata	39.5 per cent cases examined.	

Clinical co-relation.

Clinical points noted in the various histories included age of the mother, parity, infection or bleeding during pregnancy, blood pressure, and albuminuria, Wasserman, normality of delivery of child and placenta, and the gestation in weeks of the fœtus /

fœtus on delivery. At the outset it is well to state that syphilis was present in only two cases out of 200, a figure two low to base any conclusions on whatever. Other clinical data did not prove to be relevant in many instances, yet a study did reveal certain points of interest.

As regards mural thrombosis, an attempt was made to work out an index of maturity of the placenta, based on the amount of this present. To this end, a note (a naked eye estimate) was made of the amount of circumference involved by this process macroscop-:ically. In addition, sections were made of an apparently normal piece of placental tissue, usually taken from the maternal surface, and near the centre, and an average was taken of the number of villi per microscopic field (low power) involved by the process. (See Fig. 5). No definite co-relation between the amount of marginal change and the villi per field was noted. Next, the affected villi per field in placentae of varying weeks' gestation was examined (as will be readily understood, the number of placen-:tae which were considered to be at term was greatly in excess of premature and post-mature). It was found that at term, the average number of villi affected per field was 3.5. In two placentae, which were post-mature, the average number was three, whereas in premature placentae from thirty to thirty-four weeks' gestation, the average was four per field. These figures, though based on too small numbers to be /

be conclusive, were interesting. In these pregnancies which had been carried beyond term, there was apparently less mural thrombosis than in the average case at term, whereas in those cases where pregnancy had terminated too soon, there was more. There were, further, two very interesting individual cases. In a diabetic patient who was delivered of a dead and macerated twenty-four weeks' fetus, each microscopic placental field showed villi affected to the extent of 10%. In another individual case, a pregnancy which had been terminated and the uterus curetted at six weeks' gestation, there was no mural thrombosis whatever in the placental tissue.

As a further point, the average mural thrombosis per field in multiparous and primiparous placentae at term were taken. It was found that in multiparous, the figure was 3.62, and in primiparous 3.44. This difference gave rise to a little doubt at first, but on averaging the size of multiparous placentae, they were found to be larger than primiparous. In my 200 cases, the average multiparous placenta, measured on the maternal surface 18.46 cm., while the primiparous measured 17.96 cm. This suggested that the larger the placenta, the more the proportion of it that can be knocked out before maturity is reached.

All of the above conclusions pointed definitely to the fact that this process of mural thrombosis was not pathological, but represented a physiological senescent process.

It /

It is perhaps appropriate at this point to deal with another possible feature of senescence - namely, endarteritis or periarteritis of the villous vessels. Williams, Eden, and Ackermann believe that this was the essential cause of placental "infarcts". Hitschmann and Lindenthal had failed to observe such endarteritis except in syphilitic placentae, and Mont-:gomery and others have also remarked on the absence of such changes.

Out of the 200 placentae examined there was evidence of thickening of the intima and modia of certain of the villous vessels, usually, as Williams had already noted, in the medium sized villi, in 27.5 per cent of the placentae. These changes were of very different grades and involved very varying extents. (See Fig. 11). Arbitrarily, I divided these changes into four grades according to the amount of vessel obliteration and the numbers of medium sized vessels involved. It was noticeable throughout that most of the smaller arteries showed no change. On this basis grade iv which was taken to be practical obliteration of large number of the medium sized vessels occurred in one case only, or 0.5 per cent, whereas, at the other extreme, no appreciable change at all occurred in 22.5 per cent. Grade i was present in 27.5 per cent, grade ii occurred in 35.5.per cent, and grade iii in 14 per cent. No noticeable relationship was observed between the grade of arterial change and the amount of /

of mural thrombosis, and it was definitely noted that even where the medium sized villi were affected to a marked degree, they themselves and also the smaller villi round about were undegenerated.

Turning to the question of true infarction and intraplacental hematomata, in so far as all large areas of true infarction were found to be caused by retroplacental hemorrhage, these appear to be interrelated. Young's theory of eclampsia is that it is caused by the absorption into maternal circulation of the products liberated from an infarcted patch of placenta. In spite of very neat experimental work on Young's part, this theory has not been borne out by other investigators, and indeed, Young himself, sees flaws in the argument.

It has long been known that "infarcts" in the previously loosely-used sense of the word, occur more frequently in placentae from eclamptic or pre-eclamptic women. Siddell, and Hartman found infarcts of some type in toxemic placentae in 86.7 per cent. Strachan quoted figures of various writers on the percentage of kidney lesions associated with red infarction. According to him, Cagney found associated kidney lesions in 37 per cent cases, Martin found ~~in~~ them in 67 per cent cases, while Strachan himself found them in 77 per cent cases. In an article by Williams on premature separation of the placentae, which, according to the above interpretation /

interpretation of facts is the first stage in the production of infarction, he quoted figures from Gaston, Bar, Kerrily, Dorman, and Essen-Möller that showed associated albuminuria in, roughly, about 50 per cent of cases examined. Most writers seem agreed that so-called "red infarcts" in the placenta have some co-relation to the eclamptic and pre-eclamptic states, but whether these "red infarcts" belong to the type of the placental hematomata, or true infarcts is not clearly specified. In my series of cases, I have taken these two groups and examined the clinical records for blood-pressure and albuminuria. First of all, those cases which were diagnosed clinically as pre-eclamptic toxemia, or eclampsia were taken. Here it was found that the average blood pressure was 144 (systolic), and albuminuria was graded ii on a basis of iv. In these cases, 75 per cent showed intraplacental hematomata, and 50 per cent showed large true infarcts, all on a basis of retroplacental hemorrhage. In 100 per cent of these cases, one or another, or both lesions were found. Next, those cases showing true infarcts were taken, and it was found that, for these cases, the average systolic blood pressure was 155, and average albuminuria was graded ii +.

The matter was then studied from the other angle, the pathological placentae being grouped, and all those cases which showed true infarction or intra-:placental /

intraplacental hematomata being compared with those cases where the placental findings were normal. The significant clinical points examined were blood pressure and albuminuria. It was found in those cases where the placenta showed neither true infarc-:tion nor intraplacental hematomata that the average highest systolic blood pressure was 125; in those cases which presented only intraplacental hematomata the average highest systolic blood pressure was 129; in those cases presenting true infarction or true infarction plus intraplacental hematomata, the average highest systolic blood pressure was 133. Albuminuria, which had been graded on a basis of i to iv, was then averaged. In all three groups, the average condition of the urine showed albuminuria less than grade i, and the difference, when calcul-:cated to tenths, was not appreciable nor significant. These findings were particularly interesting, as they seemed to bear out the theory that possibly high blood pressure had more to do with the placental changes than the actual lesions in the kidney. Further, in view of the increasing average blood pressure in three groups (normal, hematomata, true infarcts), it would almost seem as if hematomata and true infarcts were two stages in the same pathologic-:al process.

If this surmise were correct, then Young's theory of the causation of eclampsia could not be said to be confirmed. Obviously, if high blood pressure /

pressure were the determining factor, the kidney lesion would have preceded the placental lesion, in which case one could not attribute lesions in the kidney to absorption of toxins from the infarcted area.

Conclusions.

1. It is suggested that placental lesions hitherto grouped together as "Infarcts" be subdivided into three large groups, to be called:

   a. Mural thrombosis

   b. True infarct

   c. Intraplacental hematomata

2. The first group is believed to be physio-:logic and a product of senescence.

3. The second and third groups are believed to be connected in some way with the clinical con-:ditions of pre-eclamptic toxemia and eclampsia.

4. The connecting link appears to be high blood pressure, and in so far as this follows and does not precede kidney lesions, it is unlikely that these placental abnormalities are directly responsible for the clinical conditions.

I wish to express my thanks to the Obstetrical Staff at St. Mary's Hospital, to the Staff of the Pathological Section at the Mayo Clinic, and to the Directors /

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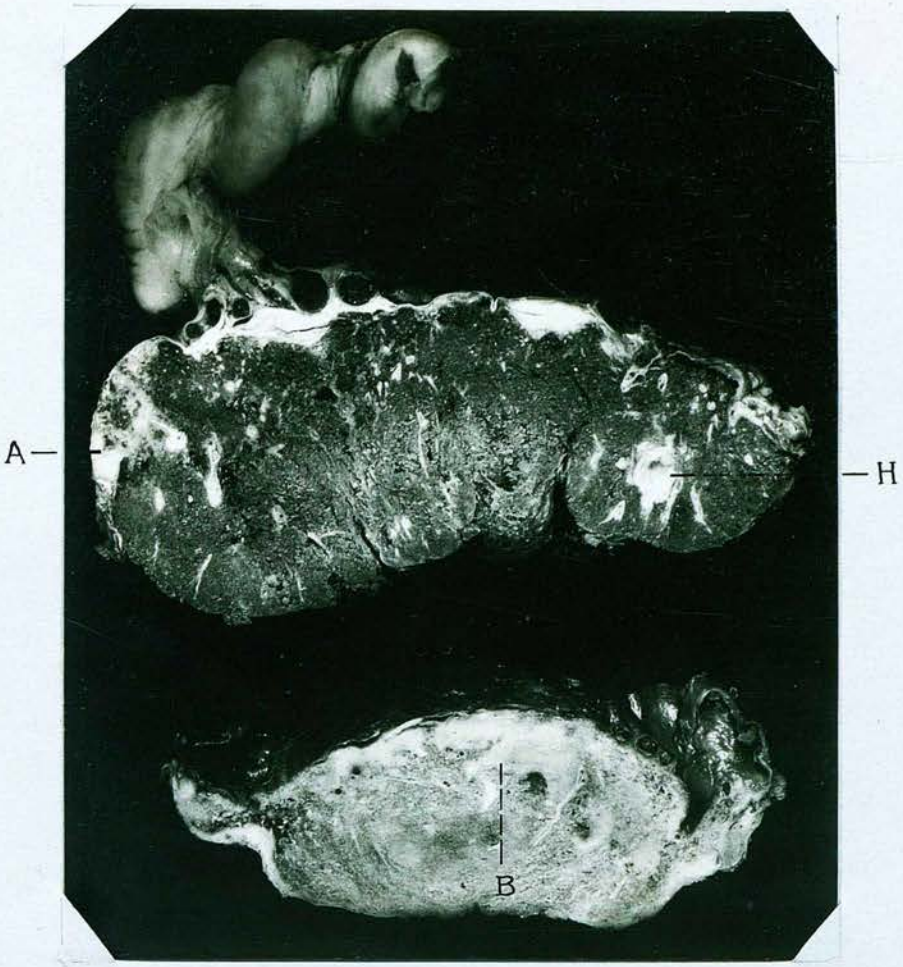

Fig.1. Cut surfaces of two placentae, showing mural thrombosis. In the first, at A, it is marginal. (In this specimen at H, a white intraplacental haematoma can also be seen.) In the second, it is marginal, and, at B, subchorionic.

Note: In this and succeeding photographs the chorionic surface is always uppermost.

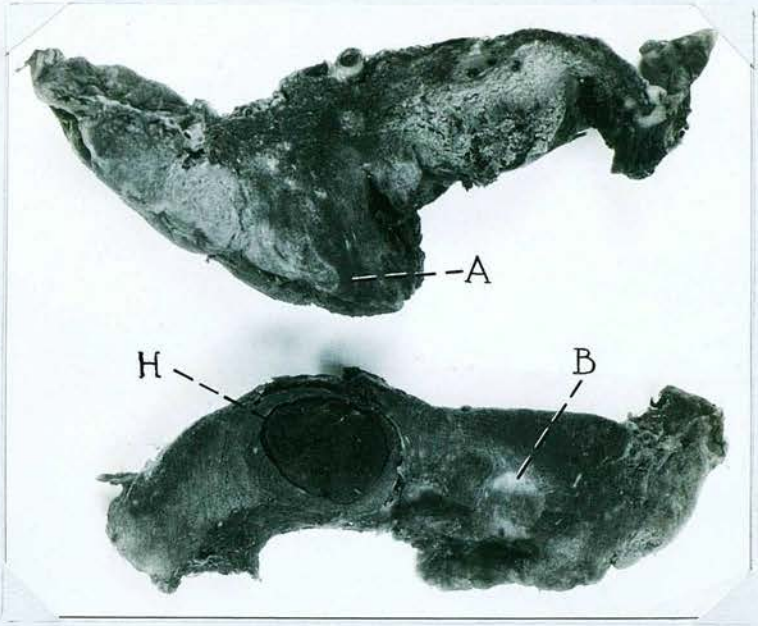

Fig.2. Cut surfaces of two placentae, showing true infarction. In the upper at A, red infarction is seen with shreds of blood clot still present on the decidual surface. In the lower, at B, is a slightly older infarction. (In this specimen, there is also present, at H, a large intraplacental haematoma.)

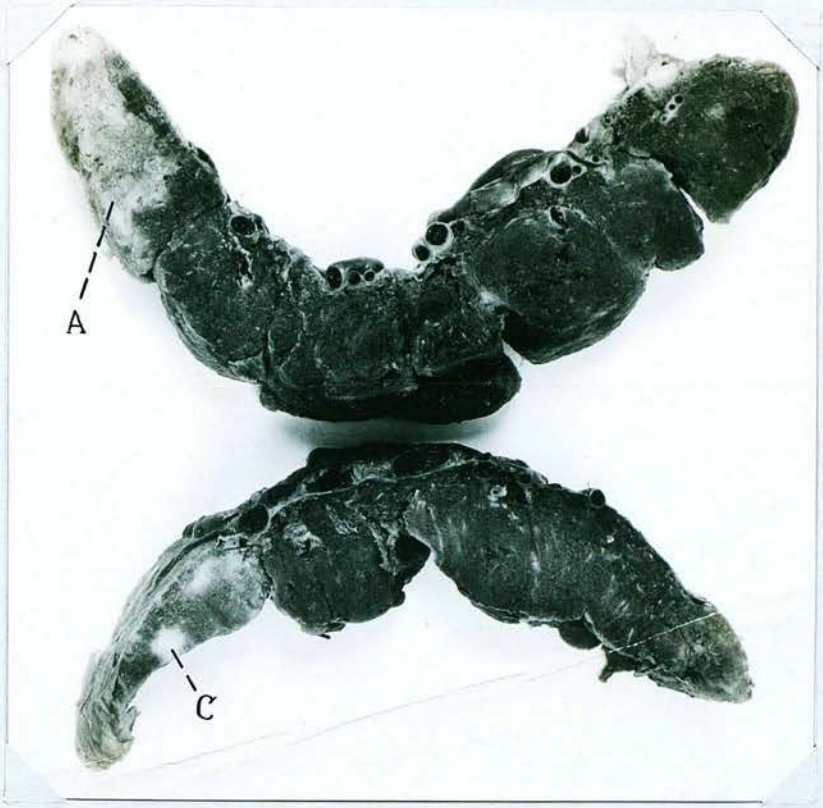

Fig.3. Cut surfaces of two placentae, showing, at A and C, later stages of true infarction. C shows the end result.

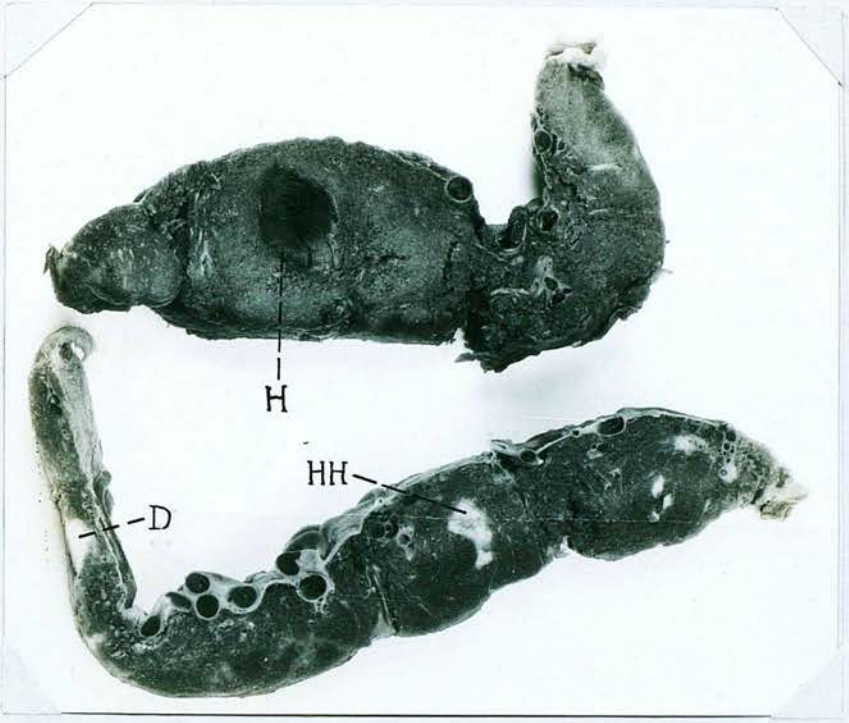

Fig.4. Cut surfaces of two placentae, showing, at H and HH, intraplacental haematomata. At H, it is recent and red, at HH, it is older and white. (At D, there is also a small area of true infarction.)

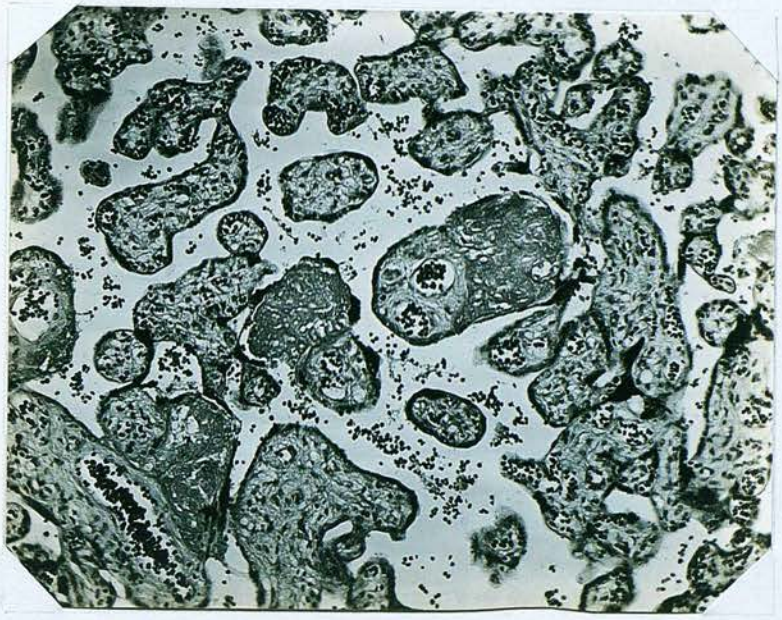

Fig.5. Section of normal, mature placenta. Three villi show mural thrombosis. (x110)

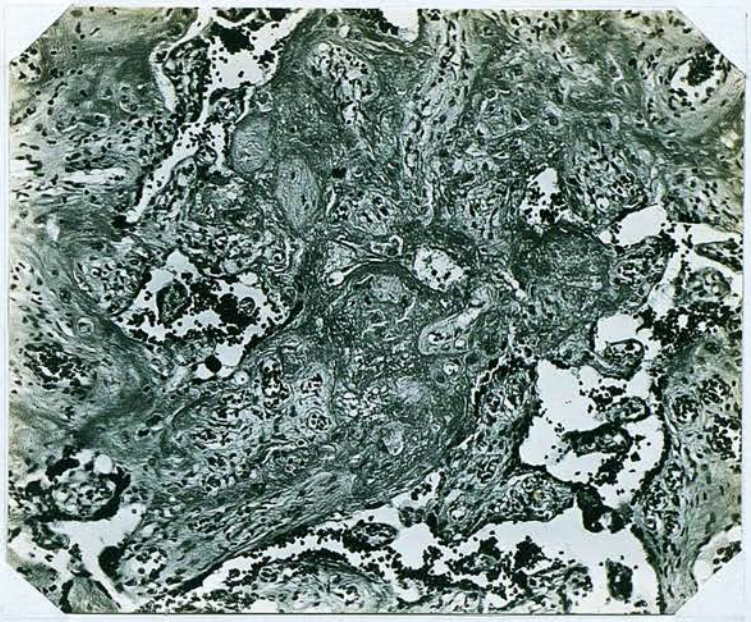

Fig.6. Section of mature placenta, showing many villi bound together by mural thrombosis. Note the absence of the syncytial layer round the villi. (x110).

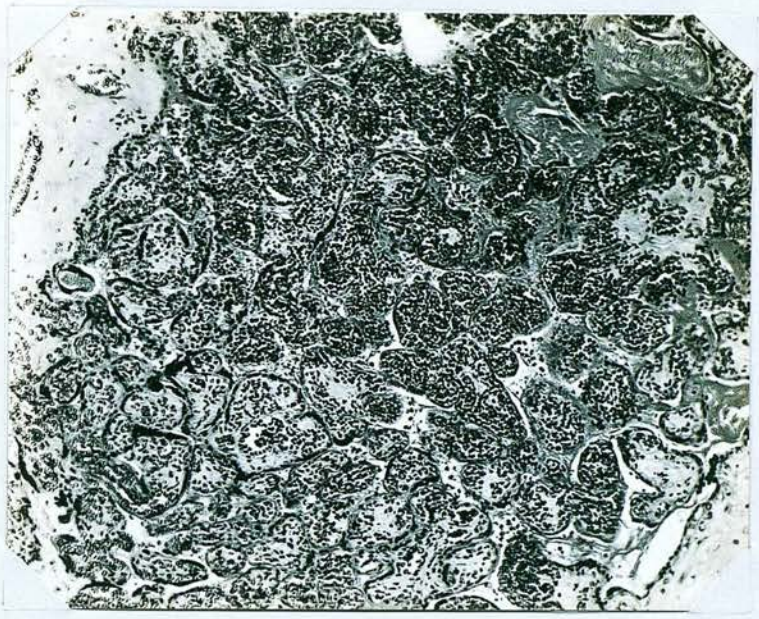

Fig.7. Section of placenta, showing early stage of true infarction. Note the congestion of the villous vessels, and practical obliteration of the maternal sinusoids. (x110)

Fig.8. Section of placenta, showing later stage in the same process. (x110)

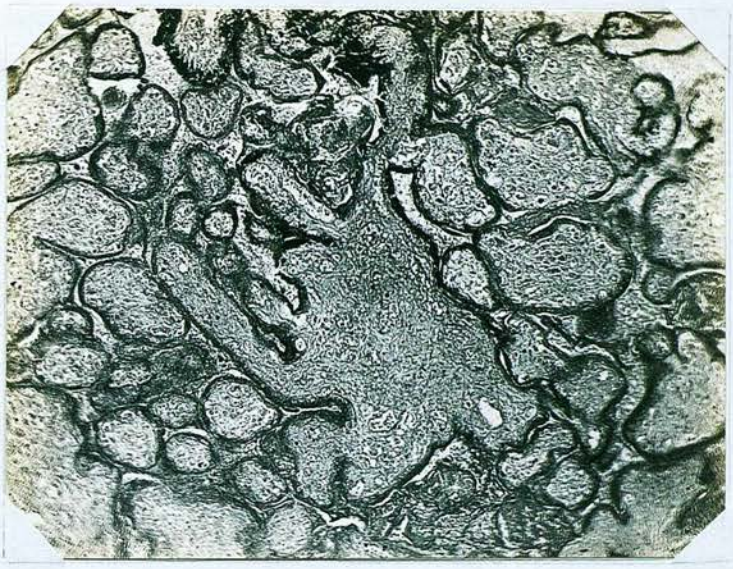

Fig. 9. Section of placenta, showing a still later stage in true infarction. Note the presence of the syncytial layer. (x110).

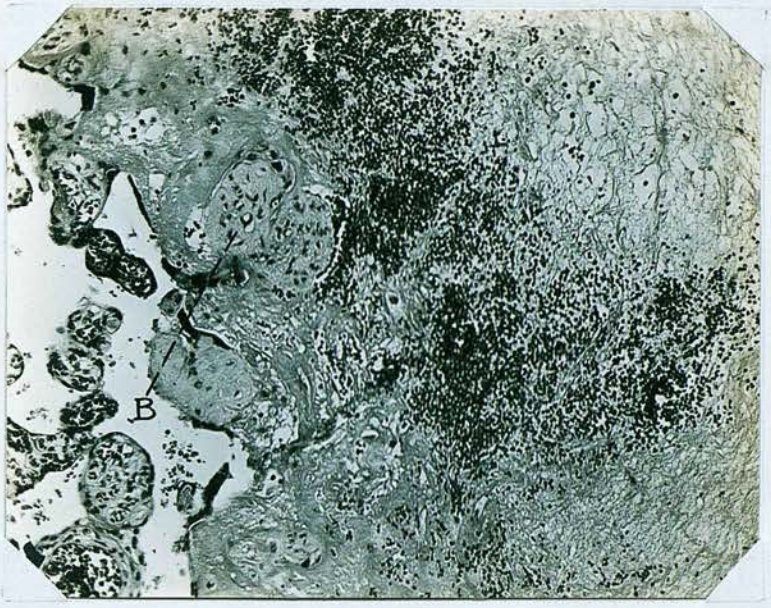

Fig. 10. Section of placenta, showing edge of intraplacental haematoma. Note, at B, the barrier formed of villi bound together by a process of mural thrombosis. (x110).

Fig. 11. Section of normal placenta, showing the type of vessel changes frequently found in the medium-sized villi. (x50).

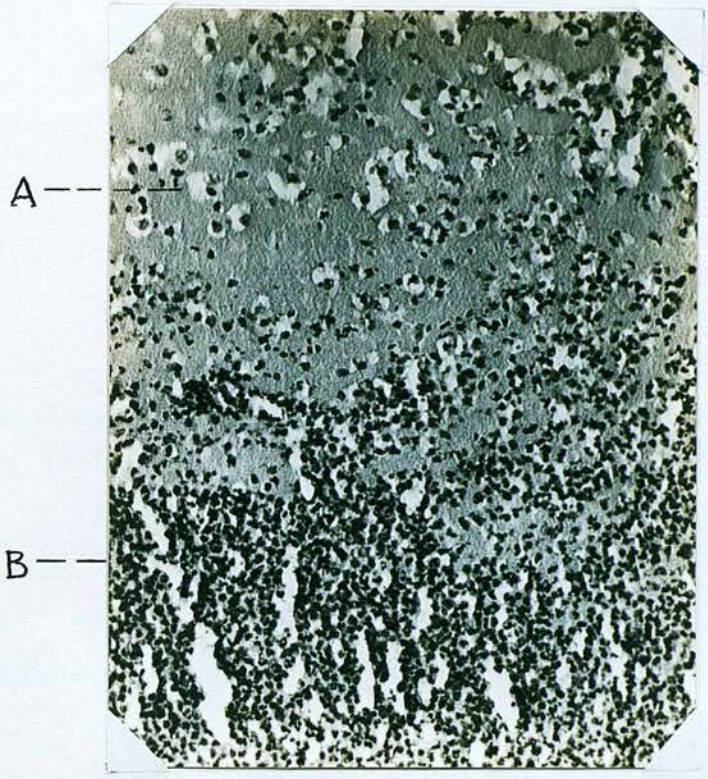

Fig. 12. Section of placenta, showing abscess formation in the decidua. Note, at A, the degenerating decidual cells: and, at B, the infiltration with polymorphonuclears. (This was unique in the cases examined.) (x200)

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